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Estonian and Finnish teachers' views about the textbooks in mathematics teaching

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This paper explores Estonian and Finnish compulsory schools' teachers' views about mathematics textbooks and how they perceive the textbooks in mathematics teaching. The data consist of compulsory schools' teachers' (N= 420) responses on a 36-item questionnaire and it was analysed by help of quantitative methods. The main findings show that both the Finnish and the Estonian teachers found the textbooks somewhat important in assuring the high and even quality in mathematics teaching. The textbooks did not particularly load the teachers. However, the findings reveal some interesting differences in this respect between contexts and between teachers with different teaching experience. Findings from this study contribute to the research-field by adding research-based knowledge about the relationships between teachers and curriculum materials.

Keywords: Mathematics teaching, teacher, textbook, curriculum materials.

Contradictory views about textbook use in mathematics teaching

Remillard and Taton (2016) state in their recent research that one of the common myths about curriculum programs and teachers is that good teachers reject textbooks and design their own curriculum. There are somewhat contradictory views about the use of textbooks and other curriculum materials among teachers and mathematics educators. Many mathematics educators emphasize the textbooks' role as the teachers' aid (e.g. Lepmann, 2005, pp.25–32) and connect teacher professionalism with teachers' independency from the guidance of textbooks or teacher guides (Oates, 2014; Hemmi & Krzywacki, 2014). O'Keeffe and O'Donoghue (2011) reported that mathematics textbooks had “an overdominant influence” in Irish classrooms and that teachers relied on the textbooks without knowing their effectiveness on teaching or learning. However, many empirical studies have raised the role of textbooks and other curriculum materials as important factors, not only for improving the quality of teaching and students' results (e.g. Stein & Kim, 2009), but also for influencing teachers' conceptions and teacher change (Remillard & Bryans, 2004; Pehkonen, 2004). The term ‘curriculum materials’ refers besides student textbooks and teacher guides to a wider package including other supplemental resources the teacher might use. A number of studies show that, depending on the character of the materials and how teachers relate to and interact with them the materials can both afford and constrain teachers' actions in mathematics classrooms (e.g. Brown, 2009; Nicol & Crespo, 2006). However, despite of the central role

textbooks are claimed to have in mathematics classrooms (e.g. Lepik & Kaljas 2010) we have surprisingly little research-based knowledge on how and what teachers think about textbooks.

This paper originally draws on previous qualitative studies about Finnish teachers (Pehkonen 2004: 2007) and is part of the Nordic project on Curriculum materials in mathematics education (Pehkonen, Hemmi, Krzywacki & Laine, 2017). The project focuses on how compulsory school teachers relate to mathematics curriculum materials (text-books, teachers' guides etc.) in different cultural contexts. Finland and Estonia are neighboring countries with close cultural and educational ties. Even the first Estonian post-Soviet national core curricula (1996) was developed in cooperation with the Finnish National Board of Education. Contemporary curriculum discourse in both countries emphasize teacher autonomy. However, there are more tensions among Estonian teachers in respect to experienced curricular autonomy than among Finnish teachers (Erss, Kalmus & Autio 2016.) The aim of this paper is to report Estonian and Finnish compulsory schools' teachers views about mathematics textbooks and how they perceive the textbooks in mathematics teaching.

Teachers have different orientations towards teaching mathematics

According to Remillard and Bryans (2004) teachers have different orientations toward using curriculum resources, which influence the way they utilize them in practice. The orientations depend on the extent to which teachers familiarize themselves with the teaching material. Remillard and Bryan define the orientation as a set of perspectives and dispositions about mathematics, teaching, learning, and curriculum that together influence how a teacher engages and interacts with a particular set of curriculum materials. Teaching experience seems to be crucial in this matter. Inexperienced teachers are most likely to engage fully with available resources (Remillard and Bryans, 2004). Confident teachers use a maths textbook when it supports their teaching principles, while insecure teachers mainly rely on the textbook and often also use the key given in the book to check the students' answers (Stipek, Givvin, Salmon, & MacGyvers, 2001). Different orientations are probably the reason the same materials can be experienced as constraints by some teachers, while others see them as affordances (Pehkonen, 2007). This reflects the contradictory image of the use of teaching materials.

Curricula in different countries describe important principles for teaching mathematics. Both Estonia and Finland have national core curriculum frameworks, but teachers and schools have to interpret and adapt them for the specific school and learning contexts. In addition, both the Finnish (Perusopetuksen opetussuunnitelman perusteet 2014) and the Estonian (Põhikooli riiklik õppekava, 2014) curricula include the requirement of the differentiation of instruction, which teachers have to consider while planning and carrying out the teaching. Taking into account the specific nature of each learner means the preparation of a lesson for a class with students of different levels and from different backgrounds. It means that the teacher has to plan different ways of introducing a new topic to make it understandable to a possibly large proportion of students. According to many mathematics educators the textbooks should contain tasks of different levels of complexity, thus providing more able students with an opportunity to solve more difficult tasks while offering simpler tasks to the students less able in mathematics (Lepmann, 2005, pp.25–32; Lepik & Kaljas,

2010). If, however, the textbook does not meet the various expectations (concerning e.g. ease of use, quality and/or quantity of tasks, quality of performance) teachers set on them they may avoid it, but in addition, textbooks can burden teachers if the books are overloaded with various tasks materials or if teachers had to do much extra work to find tasks and compile task instructions.

According to the recent OECD report (Echazarra et al. 2016, 44-47) the teaching strategies (i.e. teacher-directed instruction, student-oriented interaction and cognitive-activation instruction) among Estonian and Finnish teachers in mathematics seem to be very similar compared to the other participating countries in PISA (Programme for International Student Assessment). In both countries teachers are experienced and have full autonomy to choose the textbooks (Mathematics teaching in Europe, 2011). The teachers in the Finnish compulsory schools' have on average around 15 years' and in Estonia around 22 years' teaching experience. Teacher profession is also very appreciated in Finland: in the recent international comparative study around 60 % of all Finnish compulsory teachers reported that they believed their work is valued in the society. In Estonia the percentage (14 %) was considerably lower (Taajamo et al. 2014; 2015).

Research methodology

In both countries the sample consisted of teachers of general education schools who were teaching mathematics at the time the survey was conducted and who voluntarily agreed to answer. In Finland, the data was collected via e-questionnaire by announcing a request to participate on various teachers' professional network forums. The Estonian sample was formed of the teachers whose contact data was available on schools' websites and on the portal of Estonian Education Information System (EHIS). In addition, the Estonian researchers sent invitations to the teachers with whom they had had an earlier contact, asked them to participate and to forward the survey link to other teachers teaching mathematics at their school. In total, 420 teachers participated in the study. Of them, 198 were Estonian and 222 Finnish teachers. Most of the participants (83% of the total 420) were female teachers. In Finland (at the population level), about 74% of teachers in comprehensive schools are women, but in Estonia the percentage of female teachers is higher (86%). The Finnish sample roughly follows the teacher gender division in the compulsory schools, since 73% of the respondents were female teachers. In the Estonian sample 94% of the teachers were female. Hence, it seems that male teachers are somewhat under-represented in the Estonian sample.

The data collection instrument we used in this study has been created on base of previous qualitative interviews with Finnish teachers (Pehkonen 2004; 2007). In those studies three qualitatively different ways to speak about the use mathematics textbooks and curriculum materials had been identified: 1) justification (assuring the even quality of teaching, supporting changes), 2) critics towards textbooks and use of them and 3) feelings of guilt (or insecurity) concerning teaching of mathematics. The questionnaire has been developed based on those dimensions and formulated the items quite directly from teachers' statements. The instrument has been modified in several pilot versions with different amounts of items and data sets from different teacher populations. The version used in this study consisted of 36 items on a five-point Likert scale, where

only the end points of the scale where given, 1 – completely disagree and 5 – completely agree (Pehkonen, Krzywacki & Laine 2014). The statements were divided into blocks with five statements in each. Such division allowed the respondents to focus on only the five statements at a time they could see on the computer screen. The question blocks did not have headings dividing them into topics, and the statements were presented in a random sequence.

In explorative factor analysis (GSL and Varimax rotation) three dimensions (factors) were extracted with the resemblance to the original dimensions. The three factor solution explained 39,75% of the total variance. The first factor was labelled as Quality guarantee and it explained 18,6 %, the second factor (Burden) 13,88% and the third factor (Self-confidence) explained 7,27% of the total variance. We constructed tree scales based on the factors and items with factor loadings more than .40. We omitted the three items with the loadings (over .40) on two factors, and the two items with the loadings under .40 on each factors. The three items with negative loadings were recoded before the scale construction.

Table 1. Constructed scales with the alpha coefficients

Scale	N of items	Cronbach's alpha
Quality Guarantee	14	.89
Burden	13	.86
Self-confidence	4	.66

The constructed scales with the alpha coefficients are presented in Table 1. The first scale based on the first factor (Quality guarantee) comprised 14 items concerning the role of textbooks in the quality assurance of mathematics teaching like ‘Textbooks help me to assure the quality of instruction’ with Cronbach’s alpha of .89. The second scale was constructed of the second factor (Burden) and consisted of 13 items (dealing with various matters how the textbooks made mathematics teaching more difficult and loaded teachers) like ‘Since the mathematics textbook keeps us so busy, we do almost nothing else in mathematics classes’. Its alpha efficient was .86. The scale (Self-confidence) comprised four items of the third factor and had the alpha coefficient of .66. The third scale included items concerning teachers’ self-confidence in mathematics teaching, like ‘I consider myself an expert in teaching mathematics’.

Findings

The means and standard deviations on each scale are presented below in Table 2. We first have a look on the importance teachers attached to textbooks in ensuring the quality of teaching. The first scale (Quality Guarantee) consisted of items, which were concerned with the extent which teachers conceived the curriculum materials as a means to guarantee the high and even quality in mathematics teaching. On the average, both the Finnish and the Estonian teachers in our study found the textbooks somewhat important in assuring the quality of mathematics teachings. On the 5-point scale (from 1 to 5 were 5 refers to very great importance) the mean was 3.25 among the Finnish teachers ($SD_F = .75$) and about the same ($M_E = 3.22$; $SD_E = .64$) among the Estonian

teachers. So, there were no differences between the two countries. Teachers' gender, age and teaching experience were not related either, in this respect.

Table 2. Means and standard deviations

	Quality Guarantee		Burden		Self-confidence	
	Mean	SD	Mean	SD	Mean	SD
Estonian teachers (N=198)	3.22	.64	2.61	.62	3.69	.69
Finnish teachers (N=222)	3.25	.75	2.87	.80	3.93	.73

Secondly, we will consider to what extent teachers perceive the mathematics textbooks as burdens that restrict their working in classrooms. The second scale consisted of items concerning the straining effects of textbook in mathematics teaching. In total, the teachers in our study did not conceive the textbooks particularly burdensome. On the five-point scale (from 1 to 5, where 5 refers to a very high burden), the mean of the burden scale in the entire data set was somewhat below the middle point ($M = 2.74$; $SD = .73$). However, there were differences between the teachers. Estonian teachers found the mathematics textbooks less burdensome ($M_E = 2.61$; $SD_E = .62$) than their Finnish colleagues ($M_F = 2.87$; $SD_F = .80$). The difference between the two countries is statistically significant, but the effect size is small ($t = 3.66$, $p < .000$, $\eta^2 = .03$). There also seems to be a small difference between male ($M_m = 2.54$, $SD_m = .61$) and female ($M_f = 2.76$, $SD_f = .74$) teachers ($t = 2.05$, $p < .05$), but the effect size ($\eta^2 = .014$) is very small. In the whole sample the teaching experience was statistically significantly related to the experienced textbooks' burden ($F(2,397) = 13.48$, $p < .000$). The effect size is medium ($\eta^2 = .064$). Teachers with more than 10 years' teaching experience found the textbooks less as burdens ($M = 2.6$) than their colleagues with shorter teaching experience ($M_{<2\text{years}} = 3.02$, $M_{2-10\text{years}} = 3.02$). The differences are similar in both countries, with the exception that Finnish teachers with medium teaching experience from two to ten years found the textbooks significantly most burdensome ($M_{F2-10\text{years}} = 3.2$) than the other teachers.

Finally, we take under consideration the participating teachers' self-confidence. In total, the self-confidence in teaching mathematics was pretty good among the participants. The self-confidence was higher among Finnish teachers ($M_F = 3.93$, $SD = .73$) than among their Estonian colleagues ($M_E = 3.69$, $SD = .69$). Although the difference between the means is statistically significant ($t = 3.38$, $p < .001$), the effect size is small ($\eta^2 = .027$). Female teachers indicated somewhat lower self-confidence ($M = 3.79$, $SD = .71$) than male teachers ($M = 4.01$, $SD = .73$). The difference is significant ($t = -2.02$, $p < .05$), but the effect size is very small ($\eta^2 = .012$). Hence, we must be careful not to make any conclusions considering the gender effect in this respect. The teaching experience was related to the self-confidence in mathematics teaching. ($F(2,406) = 10.12$, $p < .000$). The most experienced teachers with more than 10 years experience had higher self-confidence ($M_{>10\text{years}} = 3.92$, $SD = .69$) than their colleagues with less experience ($M_{<2\text{years}} = 3.43$, $SD = .79$ and $M_{2-10\text{years}} = 3.64$, $SD = .71$). The effect on self-confidence is near to medium ($\eta^2 = .05$).

Discussion

We found small or medium differences between the two countries concerning comprehensive schools' teachers' views on mathematics textbook use. Teaching experience had the most powerful effect in making the differences visible. The findings indicate that teachers rely on mathematics textbooks and find that textbooks do have significance in assuring the quality of mathematics teachings. Somewhat unexpectedly, in both samples there are vague signals that teachers with minor teaching experience rely less on mathematics textbooks than teachers with more experience. This may reflect the intentions of teacher education to encourage student teachers to become critical users of texts. The connection between teaching experience and confidence on textbooks and other curriculum materials should be elaborated in future studies.

Textbooks may have different roles in different pedagogical and cultural contexts. During the Soviet time, there was a shortage of textbooks in Estonia and teachers had to prepare the teaching materials themselves. The new time brought along a good variety of textbooks to support teachers and help them with the workload. This may at least partly explain the difference in experienced burden of textbooks between the two countries.

According to Remillard and Bryans (2004) inexperienced teachers are most likely to use all the resources of the reform-oriented curriculum material. Though, it helps the new teachers to learn about mathematics education, it requires hard work. We have evidence from the previous studies (Brown 2009) that teachers' skill to perceive the affordances of the materials develops over time and teaching experience. Remillard and Bryans (2004) concluded that, "experienced teachers seem to develop pedagogical repertoires that include the ways they read and use curriculum resources". Curriculum materials can be experienced as a burden rather than an affordance if pedagogical design capacity is undeveloped and a teacher cannot utilize resources flexibly but struggles with achieving fidelity between the written and enacted curriculum (Brown, 2009; L. Pehkonen, 2007).

Our finding about the slightly lower self-confidence among the Estonian teachers is in accordance with the TALIS 2008 (OECD 2009) results, where Estonian lower secondary school teachers' self-efficacy scores were under the mean of all participating countries (see also Erss et al. 2016). We found that teaching experience was related to self-confidence in teaching mathematics, and the teachers with higher confidence in mathematics teaching found the curriculum materials less burdensome. On average, the teachers in our study felt confident teaching mathematics. It is a good signal, since there is evidence that teacher's self-confidence in mathematics education facilitates high-quality learning in pupils (Jamieson-Proctor & Byrne 2008).

The findings of this study help us to understand that textbooks can serve both as affordances and constraints in teaching mathematics. They give us reasons to conclude that Estonian and Finnish teachers rely on mathematics textbooks to help them in maintaining a high quality in of teaching, but textbooks also stress teachers. In this study, as well as in the previous study of the same project (Pehkonen et al. 2017) the teachers with medium teaching experience found the textbooks most burdensome. Hence, more research is needed about the teachers' experiences on curriculum materials as a burden to elaborate this connection.

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References

- Brown, M. (2009). The teacher-tool relationship: Theorizing the design and use of curriculum materials. In J. Remillard, B.A. Herbel-Eisenmann & G.M. Lloyd (Eds.), *Mathematics Teachers at Work — Connecting Curriculum Materials and Classroom Instruction* (pp. 17–36). New York, NY: Routledge.
- Echazarra, A., Salinas, D., Méldez, I., Denis, V. & Rech, G. (2016). How teachers teach and students learn: Successful suggesful strategies for schools. OECD Education working paper No. 130. DOI:[10.1787/5jm29kpt0xxx-en](https://doi.org/10.1787/5jm29kpt0xxx-en)
- Erss, M., Kalmus, V. & Autio, T. H. (2016). ‘Walking a fine line’: teachers’ perception of curricular autonomy in Estonia, Finland and Germany. *Journal of Curriculum Studies* 48(5), 589-609.
- Hemmi, K., & Krzywacki, H. (2014). Swedish teachers’ interplay with Finnish curriculum material – crossing the boundaries. In Jones, K., Bokhove, C., Howson, G. and Fan, L. (eds.). (2014). *Proceedings of the International Conference on Mathematics Textbook Research and Development (ICMT-2014)*, Southampton, GB, University of Southampton.
- Jamieson-Proctor, R. & Byrne, C. (2008). *Primary Teachers’ Beliefs About the Use of Mathematics Textbooks*. Retrieved the 12th January 2017 from https://eprints.usq.edu.au/4156/1/Jamieson-Proctor_Byrne_Merga_08.pdf
- Lepik, M., Kaljas, T. (2010). Eesti, Saksa, Soome ja Vene matemaatikaõpiku võrdlev analüüs. *Koolimatemaatika XXXVII* Tartu Ülikool: Tartu Ülikooli Kirjastus, 35–45.
- Lepmann, L. (2005). *Koolimatemaatika XXXII*. Tartu: Tartu Ülikooli Kirjastus, 25–32.
- Mathematics Education in Europe. Common challenges and national policies*. (2011) Education, Audiovisual and Culture Executive Agency. EACEA P9 Eurydice. Retrived the 12th January 2017 from <http://eacea.ec.europa.eu/education/eurydice>
- Nicol, C. C. & Crespo, S. M. (2006). Learning to teach with mathematics textbooks: How preservice teachers interpret and use curriculum materials. *Educational studies in mathematics*, 62(3), 331–355.
- Oates, T. (2014). *Why textbooks count*. A policy paper. Retrieved the 12th January 2017 from <http://www.cambridgeassessment.org.uk/Images/181744-why-textbooks-count-tim-oates.pdf>
- OECD (2009). Teachers matter. Attracting, developing and retaining effective teachers. First results from TALIS. OECD Publishing.
- O’Keeffe, L. & O’Donoghue, J. (2011). The use of evidence-based research on mathematics textbooks to increase student conceptual understanding. *International Journal for Cross-Disciplinary Subjects in Education* 2 (1), pp. 304–311.

- Pehkonen, L. (2004). The magic circle of the textbook—an option or an obstacle for teacher change. In M. Johnsen Høines & A. B. Fuglestad (Eds.), *Proceedings of the 26th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 3, pp. 513–520). Bergen University College.
- Pehkonen, L. (2007). To change or not to change – how primary school teachers speak about stability and change. *Nordic Studies in Mathematics Education*, 12(2), 57–76.
- Pehkonen, L. & Krzywacki, H. & Laine, A. (2014): *The role of textbooks in teaching mathematics: instrument development*. Paper presented at project workshop in Västerås 20.5.2014
- Pehkonen, L., Hemmi, K. Krzywacki, H. & Laine, A. (2017). *Constrain or guarantee of quality. A cross-cultural study of teachers' relation to curriculum materials*. Unpublished manuscript.
- Perusopetuksen opetussuunnitelman perusteet (2014). Opetushallitus. Retrieved from http://www.oph.fi/download/163777_perusopetuksen_opetussuunnitelman_perusteet_2014.pdf
- Põhikooli riiklik õppekava (2014). Riigi Teataja. Retrieved from <https://www.riigiteataja.ee/akt/129082014020>
- Remillard, J. T. & Bryans, M. B. (2004). Teachers' orientations toward mathematics curriculum materials: Implications for teacher learning. *Journal for Research in Mathematics Education*, 352-388
- Remillard, J. T. & Taton. J. (2016). Rewriting myths about curriculum materials and teaching to new standards. In J.A Supovitz & J. Spillane (Eds.), *Challenging standards: Navigating conflict and building capacity in the era of the common core* (pp. 49-58). Lahnam, MD. : Rowan & Littlefield. (Prepublication version)
- Stein, M. K. & Kim, G. (2009). The role of mathematics curriculum materials in large-scale urban reform. *Mathematics Teachers at Work: Connecting Curriculum Materials and Classroom Instruction*, 37–55.
- Stipek, D. J., Givven, K. B., Salmon, J. M., & MacGyvers, V., L. (2001). Teachers' beliefs and practices related to mathematics instruction. *Teaching and Teacher Education*, 17, 213–226.
- Taajamo, M., Puhakka, E. & Välijärvi, J. (2014). Opetuksen ja oppimisen kansainvälinen tutkimus TALIS 2013: Yläkoulun ensituloksia. [*Teaching and Learning International Survey TALIS 2013. The first results for lower secondary school.*] English Summary. Publications of the Ministry of Education and Culture 2014:15
- Taajamo, M., Puhakka, E. & Välijärvi, J. (2015). Opetuksen ja oppimisen kansainvälinen tutkimus TALIS 2013: Tarkastelun kohteena alakoulun ja toisen asteen oppilaitosten opettajat ja rehtorit. [*Teaching and Learning International Survey TALIS 2013. Examining teachers and principals in primary and secondary education*]. English Summary. Publications of the Ministry of Education and Culture 2015:4